Measure: Mandatory Cool/Energy-Star Roofing (G8)

Mandate use of cool roofing systems in Tucson on all future residential and commercial construction.

COT ARRA RFP Summary:

Emission reduction potential:	84,359 tCO_2e
Percentage of goal (2012):	0.44%
Percentage of goal (2020):	3.7%
Total annual average implementation costs:	Competitive with traditional roofing; no public funds or incentives required
Entity that bears the costs of implementation:	Developers
Cost/Savings per tCO_2e:	\$115 / tCO_2e
Net annual savings:	\$216 / home
Entity that realizes the financial return:	Homeowner; commercial building owner
Equitability (progressive/regressive, income/revenue neutral, etc):	Income/revenue neutral
Potential unintended consequences:	None

Background information:

Energy Saving Roofing: The term "cool roofs" is a generic term for roofing materials, inclusive of Energy Star products, that lower heat transfer to the building below. According to the third party, non-profit Cool Roof Rating Council, a cool roof "*reflects and emits the sun's heat back to the sky instead of transferring it to the building below*".[1] The roofing material does this via two drivers: solar reflectance and thermal emissivity. Solar reflectance is a material's ability to reflect solar radiance, and thermal emissivity a material's ability to release absorbed heat. It is important to note that the material need not be white (or similar).

Using such materials on roofs keep the roof and the building cooler than they would have been with traditional roofing. Thus, building and homeowners can lower the building cooling needs at relatively low cost, especially when the roofing project is integral with new construction or during roofing replacement. The use of this low cost, regionally appropriate measure can help Tucson citizens lower their energy bills, achieve important GHG emissions reductions, and help reduce the Urban Heat Island (UHI) effect.

Business as Usual:

Absent increased incentives and/or mandating cool roofing systems, this cost- and energy-saving measure could continue to go underutilized in the region. Tucsonan homeowners are currently missing out on over 2,200 kWh of savings per year by not installing such systems.

Description of Measure and Implementation Scenario:

The proposed measure is implementation of cool roof materials on all new home and commercial construction via a building code requirement. Projected annual new home occupancy is 3,150 homes (assumed to have a roofing area of 1,800 sqft) and 25 commercial buildings (assumed to have a roofing area of 25,000 sqft). The life cycle analysis is run for 10 years.[2] An average premium for flat and pitched cool roof materials is assumed to be $0.05/sqft installed.[3]

Has the Measure been implemented elsewhere and with what results?:

In October 2005 cool roofs became mandatory on all non-residential, low-sloped construction and re-roofing projects in California via their Title 24 Building Energy Efficiency Standards. The 2008 update to Title 24 covers may more structures, including residential and high-sloped roof applications.[4] Other States and cities have

since followed in similar fashion (for example, Georgia, Florida, Chicago and Philadelphia). [5] [6]

Currently, the State of Arizona mandates cool roofs only on State owned and funded buildings despite some very convincing case studies that implementation has energy and cost saving benefits.[7] Tucson hosted a case study on the 23,400sqft Thomas O. Price Service Center office building. During the study, cool roofing was found to save up to 50% of cooling costs to the property.[8]

Energy/Emission analysis:

Description	***Input***	***Notes***
New Single-Family Home Mandate Inputs		
New home construction average per year (minus projected vacancies)	3,150	
Average home roof size (sqft)	1,800	
Average annual electricity usage (kWh)	11,000	
Home AC electricity usage as a percentage of total (%)	50%	
Average annual electricity usage for AC per home (kWh)	5,850	
Assumed home AC savings per home via utilizing cool roof (average over year) (%)	40%	
Average annual electricity savings via utilizing cool roof (kWh)	2,200	
gCO_2e per kWh	856	Derived from PAG's GHG Inventory 2010
New Commercial Construction Mandate Inputs		
Commercial construction projects added per year	25	
Average roof square footage per project	25,000	
Projected electricity savings per project	117,000	See note (8) - converted from Btu
New Single-Family Home Mandate Totals over 10-years		
Total homes covered by policy	31,500	
Total electricity savings (2020)	69.3 M	kWh
Resulting GHG mitigation potential	59,321	tCO_2e
New Commercial Construction Mandate Totals over 10-years		

Total commercial projects added per year	25	
Total electricity savings (2020)	29.3 M	kWh
Resulting GHG mitigation potential	25,038	tCO_2e

Contribution analysis:		
COT 1990 Citywide GHG emissions (baseline):[9]	5,461,020	tCO_2e
MCPA 7% reduction target for COT:	5,078,749	
2012 BAU GHG emissions projection:	7,000,000	
2020 BAU GHG emissions projection:	7,343,141	
GHG emissions reduction to meet 7% goal (2012):	1,921,251	
GHG emissions reduction to meet 7% goal (2020):	2,264,392	
Mandatory Cool Roof- New Single-Family Homes		
Contribution of G8 Mandatory Cool Roof (2020):	59,321	tCO_2e
2020 Contribution of G8 Mandatory Cool Roof:	2.6	%
Mandatory Cool Roof- New Commercial Construction Projects		
Contribution of G8 Mandatory Cool Roof (2020)	25,038	tCO_2e
2020 Contribution of G8 Mandatory Cool Roof:	1.1	%

Economic analysis:

The economic analysis, run over a 20-year life of the roof, for the new home mandate considers the following inputs:

- The premium cost of cool roofing products is approximately $0.05[3]
- The costs per kWh are per the future energy price forecast included in this report's appendix

Given these parameters, the savings derived from reduced electricity bills result in a payback of choosing a cool roof over traditional roofing materials of less than 1 year. Over the 20-year life, the savings to the homeowner equal $4,316.

- The resulting abatement ***savings*** per tCO_2e = ***$114.60 tCO_2e***

Dr. Lisa Gartland's produced a report to the City of Tucson received a grant from the Public Technology, Inc.'s (PTI) Urban Consortium Energy Task Force[8] to analyze implementation of cool roofing on a commercial project with an existing roof that

apparently was not due for replacement. Even under these circumstances, the payback for the project as a result of energy savings of approximately $4,000/year was under 6 years. The rate of return for the project was calculated to be 16%.

Co-benefits:

Cool roofs provide an array of co-benefits above energy savings to various stakeholders.[10] They add to a building's comfort, they add life to air-conditioning capital investments, and they possibly extend the life of roofs. Moreover, reduction of energy demand during peak times can lead to not only energy savings but more stability in the electric grid.[11]

Cool roofs also provide a measure that helps mitigate Urban Heat Island effect via lowering ambient air temperatures, thus being synergetic with Tucson's probable adaptation strategies.

Equitability:

Income/revenue neutral due to cost competitiveness with traditional roofing projects.

Potential unintended consequences:

There may be some small increases to home heating bills in the winter months. However, due to the low angle of the sun and the minimal amount of heating in the region, these small increases are considered negligible.[12]

General Note: All references retrieved October through December of 2010 unless otherwise noted.

Endnotes:

[1] http://www.coolroofs.org/

[2] 10 years is a very low manufacturer's roofing warranty for EPA Energy Star approved products: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=RO

[3] Derived from http://www.epa.gov/heatisld/mitigation/coolroofs.htm; however, cool roofing systems may, in fact, extend the life of the roofing system thereby lowering a building's total life roofing costs (see co-benefits section).

[4] http://www.energy.ca.gov/2010publications/CEC-400-2010-005/CEC-400-2010-005.PDF

[5] http://www.epa.gov/heatisld/resources/pdf/CoolRoofsCompendium.pdf

[6] http://www.phila.gov/green/greenworks/energy_target2.html

[7] http://www.coolroofs.org/codes_and_programs.html

[8] http://cms3.tucsonaz.gov/files/energy/CoolCommPh2-Dr.GsFinalReport-COVERPG.pdf

[9] PAG Regional Greenhouse Gas Inventory- 2010

[10] http://continuingeducation.construction.com/article.php?L=68&C=488&P=2

[11] http://www.coolroofs.org/documents/IndirectBenefitsofCoolRoofs-WhyCRareWayCool.pdf

[12] http://www.coolroofs.org/HomeandBuildingOwnersInfo.html